CLAIMS

Apparatus Claims

1. A spring structure comprising:

a substrate;

a spring metal finger including an unlifted anchor portion attached to the substrate and a released claw portion extending over the substrate, wherein the anchor portion has a first internal stress gradient; and

a stress-balancing pad formed on the anchor portion of the spring metal finger, wherein the stress-balancing pad has a second internal stress gradient that is opposite to the first internal stress gradient.

2. The spring structure according to Claim 1, wherein the second internal stress gradient of the stress-balancing pad is equal in magnitude to or greater in magnitude than the first internal stress gradient of the anchor portion.

3. The spring structure according to Claim 1, wherein both the spring metal finger and the stress-balancing pad consist essentially of a single material composition.

4. The spring structure according to Claim 3, wherein the single material composition is one of Molybdenum (Mo) and Molybdenum-Chromium (MoCr).

5. The spring structure according to Claim 3, further comprising an etch stop layer formed between the anchor portion of the spring metal finger and the stress-balancing pad.

6. The spring structure according to Claim 5, wherein both the spring metal finger and the stress-balancing pad consist

essentially of Molybdenum (Mo), and wherein the etch stop layer comprises Chromium (Cr).

7. The spring structure according to Claim 5, wherein both the spring metal finger and the stress-balancing pad consist essentially of Molybdenum-Chromium (MoCr), and wherein the etch stop layer comprises Titanium (Ti).

8. The spring structure according to Claim 1, wherein the spring metal finger comprises a first material, and wherein the stress-balancing pad comprises a second material that is different from the first material.

9. The spring structure according to Claim 8, wherein the first material consists essentially of a Molybdenum-Chromium alloy (MoCr), and wherein the stress-balancing pad consists essentially of Molybdenum (Mo).

10. The spring structure according to Claim 8, wherein the first material consists essentially of Nickel-Zirconium (NiZr), and wherein the second material consists essentially of Titanium that is solution hardened with Silicon (Ti:Si).

11. The spring structure according to Claim 1, further comprising a support pad formed between the substrate and the anchor portion of the spring metal finger.

12. The spring structure according to Claim 11, wherein the support pad comprises one of Titanium (Ti) and Silicon (Si).

13. The spring structure according to Claim 11, wherein the support pad comprises Ti, wherein both the spring metal finger

and the stress-balance portion comprise Molybdenum (Mo), and wherein the spring structure further comprises an etch stop layer consisting of Chromium (Cr) that is formed between the spring metal finger and the stress-balance portion.

14. The spring structure according to Claim 11, wherein the support pad comprises Si, wherein both the spring metal finger and the stress-balance portion comprise Molybdenum-Chromium (MoCr), and wherein the spring structure further comprises an etch stop layer consisting of Titanium (Ti) formed between the spring metal finger and the stress-balance portion.

15. The spring structure according to Claim 11, wherein the support pad comprises Titanium (Ti), wherein the spring metal finger comprises Molybdenum-Chromium (MoCr), and wherein the stress-balance portion comprise Molybdenum (Mo).

16. The spring structure according to Claim 11, wherein the support pad comprises Ti, wherein the spring metal finger comprises Nickel-Zirconium (NiZr), and wherein the stress-balance portion comprises Titanium that is solution hardened with Silicon (Ti:Si).

17. The spring structure according to Claim 11, further comprising a conductor formed on the substrate,

wherein the support pad comprises an electrically conductive material, and

wherein the spring metal finger is electrically connected to the conductor via the support pad.

18. A spring structure comprising:

a substrate;

a spring metal finger having an anchor portion supported by the substrate and a claw portion extending over the substrate; and

a stress-balancing pad formed over the anchor portion of the spring metal finger,

wherein the spring metal finger is formed from a first stress-engineered material having a first internal stress moment that causes the claw portion to bend away from the substrate, and

wherein the stress-balancing pad is formed from a second stress-engineered material having a second internal moment that opposes to the first internal stress moment.

19. The spring structure according to Claim 18,

wherein the first internal stress moment of the anchor portion has a first magnitude, and

wherein the second internal stress moment of the stress-balancing pad has a second magnitude that is equal to or greater than the first magnitude.

20. A method for fabricating a spring structure on a substrate, the method comprising:

forming a spring metal island on a release material island such that the spring metal island has a first internal stress;

forming a stress-balancing pad only over an anchor portion of the spring metal island, wherein the stress-balancing pad has a second internal stress that is opposite to the first internal stress; and

selectively removing a portion of the release material island located under a claw portion of the spring metal island

such that the claw portion bends away from the substrate and the anchor portion remains attached to the substrate.